
सिरैमिक टाइलें — परिक्षण पद्धतियां,
नमूने लेने तथा स्वीकार्यता का आधार
भाग 7 काँचाभ रहित टाइलों की धब्बे से एवं
रासायनिक प्रतिरोधिता ज्ञात करना
(दूसरा पुनरीक्षण)

**Ceramic Tiles — Methods of Test,
Sampling and Basis for Acceptance**

**Part 7 Determination of Stain and Chemical
Resistance of Unglazed Tiles**

(Second Revision)

ICS 91.100.23

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FOREWORD

This Indian Standard (Part 7) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

This standard (Part 7) was first published in 1993 and subsequently revised in 2006. This second revision incorporates the experience gained with the use of its first revision and brings the standard in line with the latest developments in this field.

The following are the significant modifications incorporated in the revision:

- a) Determination of resistance to stain has been added;
- b) Title of the standard has been modified to reflect inclusion of stain test; and
- c) Classification of tiles based on resistance to stain has also been introduced.

This Indian Standard is published in several parts. The other parts in this series are:

- Part 1 Determination of dimensions and surface quality
- Part 2 Determination of water absorption and bulk density
- Part 3 Determination of moisture expansion using boiling water
- Part 4 Determination of linear thermal expansion
- Part 5 Determination of resistance to thermal shock
- Part 6 Determination of modulus of rupture and breaking strength
- Part 8 Determination of stain and chemical resistance of glazed tiles
- Part 9 Determination of crazing resistance of glazed tiles
- Part 10 Determination of frost resistance
- Part 11 Determination of resistance to surface abrasion of glazed tiles
- Part 12 Determination of resistance to deep abrasion of unglazed tiles
- Part 13 Determination of scratch hardness of surface according to Mohs' scale
- Part 14 Determination of impact resistance by measurement of coefficient of restitution
- Part 15 Sampling and basis for acceptance
- Part 16 Determinations of lead and cadmium given off by glazed tiles

In the formulation of this standard, considerable assistance has been derived from ISO 10545-13 : 2016 'Ceramic tiles — Part 13: Determination of chemical resistance' and ISO 10545-14 : 2015 'Ceramic tiles — Part 14 : Determination of resistance to stains'.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

*Indian Standard***CERAMIC TILES — METHODS OF TEST, SAMPLING
AND BASIS FOR ACCEPTANCE****PART 7 DETERMINATION OF STAIN AND CHEMICAL
RESISTANCE OF UNGLAZED TILES***(Second Revision)***1 SCOPE**

This standard (Part 7) covers a method of test for determining the stain and chemical resistance of the proper surface of all unglazed ceramic tiles.

2 PRINCIPLE

2.1 Determining the resistance to stains by maintaining test solutions in contact with the proper surface of the tiles for a certain duration. The surfaces are then subjected to defined cleaning methods and inspected for visual changes.

2.2 Subjecting the test specimens to the action of the chemical reagents and test solutions for a defined period of time and visually examining the surface for chemical attack.

3 STAINS AND REAGENTS**3.1 Staining Agents**

3.1.1 Green Paste Staining Agent — The test paste shall contain 40 percent (*m/m*) of chromium oxide (Cr_2O_3) with an average grain size of 3 micron dispersed in a light oil composed of an ester of glycerol and organic acid, such as glyceryl monocaprates or glyceryl tributyrates.

3.1.2 Red Paste Staining Agent (Only Applicable for Green Coloured Tiles) — The test paste shall contain 40 percent (*m/m*) of iron oxide (Fe_2O_3) with an average grain size of 1 micron dispersed in a light oil composed of an ester of glycerol and organic acid, such as glyceryl monocaprates or glyceryl tributyrates.

3.1.3 Iodine, 13 g/l solution in alcohol.

3.1.4 Olive Oil

3.2 Household Chemicals

3.2.1 Ammonium Chloride Solution, 100 g/l.

3.3 Swimming Pool Salts — Sodium hypochlorite solution, 20 mg/l prepared from technical grade sodium hypochlorite with about 13 percent (*m/m*) of active chloride.

3.4 Acids and Alkalis**3.4.1 Low Concentration**

- a) Hydrochloric acid solution, 3 percent (*v/v*), prepared from concentrated acid ($\rho = 1.19 \text{ g/ml}$).
- b) Citric acid solution, 100 g/l.
- c) Potassium hydroxide solution, 30 g/l.

3.4.2 High Concentration

- a) Hydrochloric acid solution, 18 percent (*v/v*), prepared from concentrated acid ($\rho = 1.19 \text{ g/ml}$).
- b) Lactic acid solution, 5 percent (*v/v*).
- c) Potassium hydroxide solution, 100 g/l.

3.5 Cleaning Agents

- a) Hot water at a temperature of $55 \pm 5^\circ\text{C}$.
- b) *Weak cleaning agent* — A commercial agent not containing abrasive, with a pH of 6.5 to 7.5.
- c) *Strong cleaning agent* — A commercial agent containing abrasive, with a pH of 9 to 10.
- d) Hydrochloric acid solution, 3 percent (*V/V*), prepared from concentrated acid ($\rho = 1.19 \text{ g/ml}$).
- e) Potassium hydroxide.
- f) Acetone.

4 APPARATUS

4.1 Vessel with lid made of borosilicate glass or any other suitable material.

4.2 Drying Oven, capable of being operated at $110 \pm 5^\circ\text{C}$.

4.3 Chamois leather.

4.4 White cloth made of cotton or flax.

4.5 Balance, accurate to 0.05 g.

4.6 Electric lamp of 40 W, white inside.

5 TEST SPECIMEN

5.1 Stain Test

Five unused and undamaged whole tiles or if the tiles are very large, they may be cut to a dimension of 200 mm × 200 mm. The test specimen shall be thoroughly cleaned with water and then dried in the oven adjusted to a temperature of $110 \pm 5^\circ\text{C}$ until a difference in mass of less than 0.1 g is reached between two successive weighing.

5.2 Chemical Resistance Test

Five test specimens shall be used with each test solution. The specimens shall be cut from whole tiles that are free from surface defects to a dimension of 50 mm × 50 mm such that at least one side of each test specimen is not a cut side.

The surface of the specimens shall be thoroughly cleaned with a suitable solvent, such as methanol. The test specimen shall be thoroughly cleaned with water and then dried in the oven adjusted to a temperature of $110 \pm 5^\circ\text{C}$ until a difference in mass of less than 0.1 g is reached between two successive weighing.

6 PROCEDURE

6.1 Stain Test

Spread 3 or 4 drops of the paste (*see 3.1.1 or 3.1.2*) on to the surface of the test specimen. Place 3 or 4 drops of each of the solution (*see 3.1.3 and 3.1.4*) to cover separate areas of the tile surface. Place a convex watch glass of an approximate diameter of 30 mm on the applied drops, in order to spread them to an approximately circular area. Leave the staining agents in place for 24 h.

6.2 Chemical Resistance Test

Use the test solutions listed in **3.2**, **3.3**, and **3.4**. Immerse the test specimens vertically to a depth of 25 mm in the vessel containing the test solution. The non-cut side of each test specimen shall be fully immersed. Cover with the lid and maintain at $24 \pm 2^\circ\text{C}$ for 12 days.

After 12 days subject the test specimen to running water for 5 days and then boil them for 30 min while completely immersed in water. Remove the test specimen from the water, dab with a wet, but wrung-out chamois leather and dry in the oven adjusted to $110 \pm 5^\circ\text{C}$.

7 ASSESEMENT OF RESULT AND CLASSIFCIATION OF RESISTANCE CLASS

7.1 Stain Test

Attempt to remove stains by subjecting the test specimens treated according to **6.1**, to the successive

cleaning procedures (procedures A, B, C, D). After each cleaning procedure, dry the test specimen in the oven at a temperature of $110 \pm 5^\circ\text{C}$ and subject them to a visual examination. Examine the surface with naked eye or with spectacles, if usually worn, at a distance of 25 to 30 cm in daylight or artificial illumination of 300 lux.

7.1.1 Procedure A

Clean the test specimen with running hot water [*see 3.5 a*] for 5 min. Then wipe the surface with a damp cloth.

7.1.2 Procedure B

Clean the test specimen manually with the weak cleaning agent [*see 3.5 b*], using a natural, non-abrasive sponge or a cloth, then rinse with running water and finally wipe it with a damp cloth.

7.1.3 Procedure C

Clean the test specimen mechanically for 2 min with the strong cleaning agent [*see 3.5 c*], using an apparatus with a rotating brush with hard bristle having a diameter of 8 cm and with an rpm of 500 rev/min. Then rinse the surface with running water and wipe with a damp cloth.

7.1.4 Procedure D

Immerse the test specimen for 24 h in a suitable solvent [*see 3.5 d*), *e*), *f*)], and thoroughly rinse with running water and wipe with a damp cloth. Cleaning is considered to be accomplished, if any one of the solvents **3.5 d**) or **3.5 e**) or **3.5 f**) removes the stain.

7.1.5 The stain resistance performance of the tile shall be classified as shown in Fig. 1. After each stain cleaning procedure in accordance with **7.1.1** to **7.1.4**, if there is no visible effect, that is, if the stain has been removed, record the clean-ability class according to Fig. 1. If the stain is not removed, proceed to the following cleaning procedure. Class 5 corresponds to the greatest ease of removing the particular stain; Class 1 corresponds to the impossibility of removing the particular stain with any of the test procedures and/or to irreversible damage to the proper surface.

7.2 Chemical Resistance Test

7.2.1. Examine the test specimens at a distance of 25 to 30 cm with the naked eye or with spectacles, if usually worn, for changes on the proper surface and the non-cut edge. Then examine the parts of the cut edges that were immersed. Daylight or artificial illumination is permitted (approximately 300 lux), but direct sunlight shall be avoided. Any changes to the tiles surface due to chemical attack, other than a slight change in hue, shall be noted.

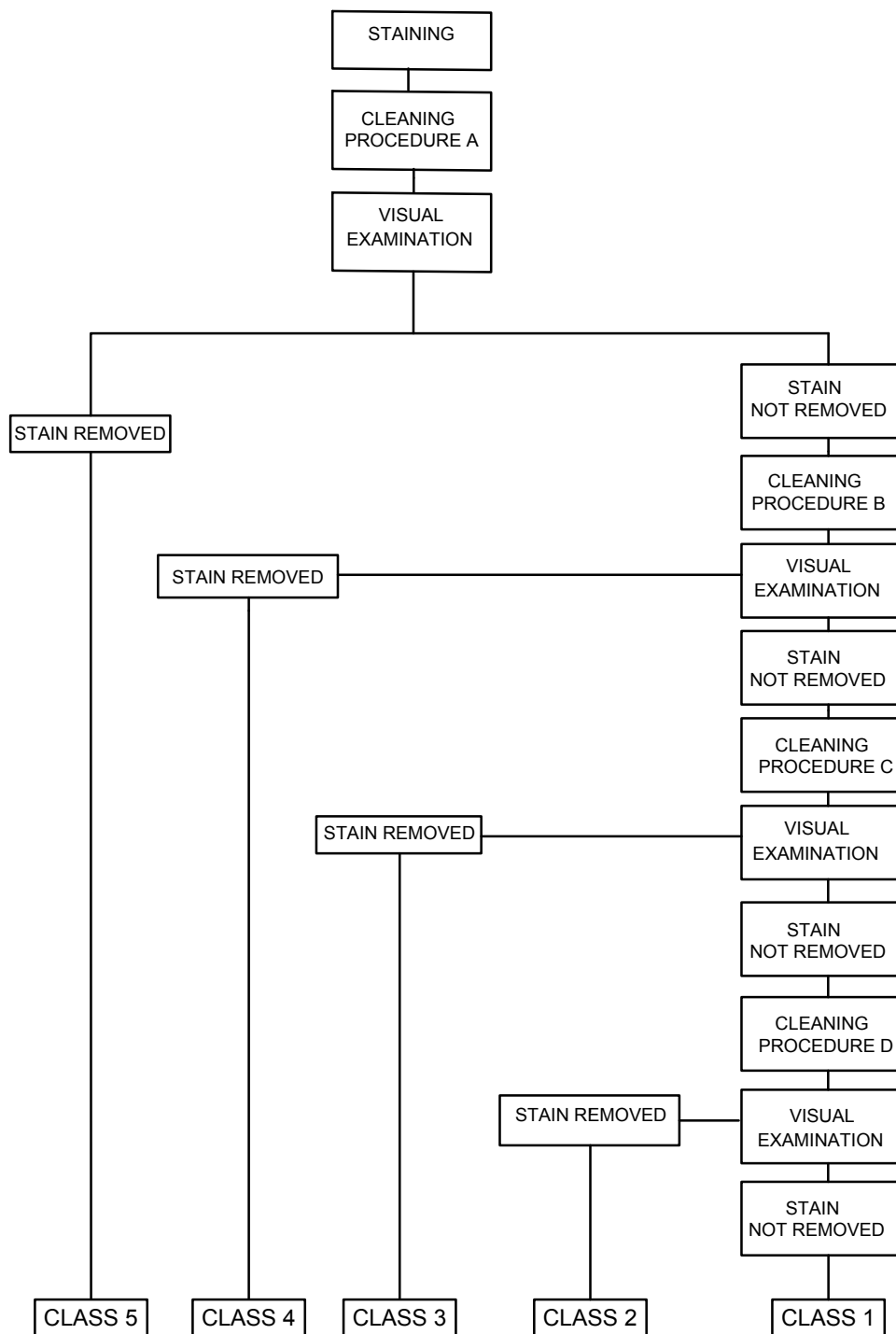


FIG 1. CLASSIFICATION SCHEME FOR STAIN TEST

7.2.2 Tiles shall be classified as follows:

- a) For test solutions listed in **3.2** and **3.3**:
 - 1) Class UA — No visible effect.
 - 2) Class UB — Visible effect on cut sides.
 - 3) Class UC — Visible effect on cut sides, not cut sides and on the proper surface.
- b) For test solutions listed in **3.4.1**:
 - 1) Class ULA — No visible effect.
 - 2) Class ULB — Visible effect on cut sides.
 - 3) Class ULC — Visible effect on cut sides, not cut sides and on the proper surface.
- c) For test solutions listed in **3.4.2**:
 - 1) Class UHA — No visible effect.
 - 2) Class UHB — Visible effect on cut sides.
 - 3) Class UHC — Visible effect on cut sides, not cut sides and on the proper surface.

8 TEST REPORT

The test report shall include the following information:

- a) Description of the tiles, including the means of preparation of test specimens;
- b) Stains and reagents used in the test;
- c) Results obtained from the procedure described in **6**; and
- d) Classification of stain resistance and chemical resistance for each stain and test solution, and for each test specimen in accordance with **7**.

ANNEX A*(Foreword)***COMMITTEE COMPOSITION**

Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

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